



March 24, 2013; Circulation: 153,847

LOCAL ISSUE: Road salt alters ecosystems; Can the wood frog survive?

The two recent halfhearted snowstorms were just a feeble parting shot of winter for North Jersey residents, but for a local species of frog emerging from hibernation to breed in the coming weeks, the storms were both a blessing and a curse.

The snows quickly melted, filling the vernal pools where many species of amphibians will lay their eggs. But the runoff also contained salt that road crews had spread during the storms — which even at very low concentrations can significantly reduce the survival of frog eggs and larvae.

New research by Lisa Hazard, an ecologist at Montclair State University, indicates that the situation might be particularly dire for the wood frog because the adults seem unable to detect elevated levels of salt in the water they might breed in.

Hazard tested the eastern newt, spotted salamander, green frog, leopard frog, northern gray tree frog and other local species by placing them in laboratory dishes filled with varying degrees of salty water. Most quickly jumped out. The wood frog, however, stayed put.

It's a bad sign for the long-term prospects of the wood frog, given the use of road salt in the region, scientists said. "You may have a species that breeds in an environment they can't tell is bad for them," Hazard said. "As a result, the population could disappear in a given area."

Though salt has been used on roads for more than half a century, scientists are just now understanding its effects on ecosystems. It is one of a number of contaminants that build up on road surfaces and wash into the surrounding landscape during storms. The pollution builds year by year. In North Jersey, salt washing off roads has made its way into the drinking water supply at levels sufficient enough to require water companies to issue warnings to residents on low-salt diets. Hazard's research into the breeding habits of frogs and salamanders is another indication that road salt pollution in the area is taking a toll.

While testing the frogs in dishes of salted water, Hazard found that, at very low concentrations of salt, most species stayed in the dish for 10 minutes. At higher concentrations, they often jumped out in less than a minute.

That makes sense, because extended exposure can harm a frog. The salt pulls vital moisture out of its body. "It's like salting a slug," Hazard said.

But in what Hazard called a "bizarre exception" among the species, "wood frogs never switched over to show aversion" to the salty water, she said.

Wood frogs are unusual. Because they breed earlier than other amphibians, they have developed a way to survive freezing temperatures, given the variability of late winter weather. Wood frogs suck the water out of their cells into a central body cavity, because otherwise, the body fluids would freeze into ice crystals that would shred the animal's cell structure.

"They actually freeze solid — the heart stops, the brain shuts down — and then they can thaw out and survive," Hazard said.

But the frog hasn't been able to adapt to salty water. "The wood frogs were just plain insane," Hazard said. "They would spend 10 to 30 minutes just sitting in water that was about as salty as seawater. It raised a new question — were they unable to even detect the salt? Would it kill them if they landed in a salty pond near a roadside? Or did they have some greater tolerance for the salt than other frog species?"

She measured the frogs' body mass, which declined the more time they spent in salty water — even mildly salty water — indicating the salt was pulling water out of their bodies. And if the salt was affecting the breeding adults, it certainly would affect their eggs.

"It's a trade-off between the environmental impact of using salt and driver safety," Hazard said. "There may be ways we can modify the application of road salt in critical habitats, without compromising safety."

Over the past decade, road crews have experimented with alternatives to pure rock salt. Some towns now use a liquefied version, called brine, which gets sprayed on roadways before a storm hits. As a result, road crews use less salt, reducing salt runoff. But salt is still an essential tool for making the roads safe for drivers.

During the winter that just ended, for instance, the New Jersey Turnpike Authority used more than 77,000 tons of rock salt on the turnpike and Garden State Parkway. And Bergen County typically uses 32,000 tons of rock salt on county roads each winter.

Besides the wood frogs, research suggests that some bugs that breed in these pools of water are also very sensitive to the salt. This is good news for the salt-tolerant mosquitoes, because the fewer bug and wood frog eggs and larvae in the puddles, the more room mosquitoes have to breed.

Steven Brady, a researcher at Yale University, has found that salt has a negative effect on the survival rate of amphibian eggs. But he also discovered that some species adapted to the salt. The eggs of spotted salamanders placed in salty pools did about 25 percent better than those of wood frogs in the same tainted pools, he said.

The salamanders, in just the 60 years that salt had been used on roadways, may have more quickly adapted to the changing environment than wood frogs, he said. "It also could be that something inherited in the wood frogs compromises them," Brady said. "It could be the contamination is being passed on from the adults to the eggs.

"If we're aiming to conserve the diversity of our ecosystems, the message here is it's more complicated than it might appear," Brady said. "The salamanders are perhaps a more hopeful story, since they seem to be adapting. Perhaps we could then focus our triage on species like the wood frog, which are not adapting."

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